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Between the Venetian Alps and the Emilian Apennines (Northern Italy): Highland vs. lowland occupation in the early Mesolithic

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ABSTRACT

The territory extending between the Venetian Alps and the Emilian Apennines is formed by a mosaic of environments which span from high mountains to hilly and plain areas. These present rather varied features from one extreme (Alpine watershed) to the other (Emilian Apennines watershed). In the early Holocene, the plain area included between the two mountain chains – the Venetian-Po plain – was extended some tens km to the south with respect to the present day coast.

This vast territory has been the object of research since the 1970s and 1980s. Field activities have allowed identifying a rich set of sites that occupy different topographic and geographic locations, thus composing an articulated mosaic characterised by a much wider variability with respect to the well-known case of the Adige basin, located at the western limit of the examined area, which is exclusively included within a mountain territory.

In this paper, we analyse for the first time the rich record from this area in its whole with the aim of investigating the territorial organisation of hunter–gatherer groups on a wide scale. This research has allowed us to set hypotheses on the mobility and occupation strategies of human groups and on the key-aspects that may have favoured the extensive and intensive occupation of this area. Besides the supposed presence of a biomass compatible with the demographic increase that has characterised this period, we also suggest that the "pragmatic" Sauveterrian technological systems played an important role in the adaptation of early Mesolithic hunter–gatherers to the varied ecosystems offered by this area.

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1. Introduction

The definition of settlement strategies and mobility patterns represents one of the main topics in the study of prehistoric hunter–gatherers. As indicated by ethnographic data these aspects are subject to considerable variability, which involves both the intensity and the modality of displacements. Particularly they are strictly related to the environment and to the availability of resources in terms of distribution and abundance as first recognised by Binford (1980). These factors, to which social interactions should be added, do influence not only the type of mobility but also the total area of land exploited by each group. A strong relationship is recognised between the latter aspect and the nature of the foraging (hunting vs. fishing vs. gathering) in a particular environment based on the assumption that, "high-return-rate resources can be procured at a longer distance from camps than low-return-rate resources" (Kelly, 2007, p. 131). According to the same author, this aspect is clearly shown in the present populations by the fact that hunting becomes more important towards the pole where the fauna need larger territories. He therefore clearly states that, "as dependence on hunting increases, the size of the territory increases", while hunter–gatherers that either base their activities on fishing or that integrate hunting with gathering usually move shorter distances.

From an archaeological point of view, it is usually recognised that the possibility to set hypotheses on the extension of territories of past populations and on their mobility is strictly dependent on the availability of a sufficiently rich record of sites (geographic and topographic location) along with multidisciplinary data attesting the natural resources exploited (raw materials that can give information about the distances covered) and consumed (vegetal and animal). Further information may come from the types of activities

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carried out within the sites as well as from their internal organisation (Geneste, 1991; Newell and Constandse-Westermann, 1996; Cusinato et al., 2003; Djindjian, 2009).

Northern Italy extends from the Southern Alps to the northern slope of the Apennines including the widest plain of the peninsula, the Venetian-Po plain (Fig. 1). This area has one of the richest Mesolithic records in Europe, which appears mostly concentrated in its eastern sector, corresponding to the area included between the present regions of Lombardia to the northwest, Friuli to the northeast, and Emilia to the south. Most of the known sites are surface lithic scatters while a smaller group has been the object of extensive excavations and multidisciplinary studies. Among this evidence, a discrete set of Sauveterrian (early Mesolithic) sites is known (Biagi et al., 1980; Broglio, 1980; Dalmeri and Pedrotti, 1992; Fontana, 2011; Fontana et al., 2013).

Research over this territory has mostly focused on Alpine and Apennine territories which are also those that yielded the first evidence in the late 1960s and early 1970s. Here, sites were first identified after quarry and road works carried out along the sides of the Adige valley-bottom (south-eastern Alps) and in the highlands of the Alps and the Emilian Apennines (1300–2300 m a.s.l.), especially in open-air areas subject to erosion processes and/or animal/anthropic activities, and more rarely under rock boulders (Broglio, 1980; Fontana et al., 2011; Broglio, 2015). Besides this rich record, starting from the 1980s other Sauveterrian sites, although less numerous, have been discovered in the Po and Venetian plains, highlighting that Mesolithic hunter–gatherers had potentially occupied the whole northeastern Italian territory.

Strictly related to the abundance of the available evidence, the definition of settlement strategies has so far focused on mountain districts, which have been considered as close systems. Most significantly, a model based on the seasonal mobility of groups from the valley-bottoms to the highlands has been proposed in the 1980s for the upper course of the Adige river basin (Trentino Alto-Adige region). This model has been supported by evidence of the use of the same lithic resources across this territory and the environmental constraints imposed by the frequentation of high altitude pastures (Broglio, 1980; Broglio and Lanzinger, 1990; Broglio and Improta, 1994–95). Only recently, starting from ethnographic data the hypothesis of the presence of a larger territory that could include both the mountainous and plain area of North-eastern Italy has been postulated (Grimaldi, 2005) and the richness and importance of the evidence highlighted in the plain area has been underlined (Fontana, 2011). Differently from the Alpine territory, in the Southern Po plain, lowland and Apennine sites have been considered as part of the same settlement system (Fontana et al., 2011).

Starting from these considerations, we have focused our attention on part of this vast territory between the Venetian Alps and the Emilian Apennines, in order to investigate the territorial organisation of early Holocene Sauveterrian hunter–gatherers. In contrast to the Trentino (Adige valley) area, which is exclusively comprised within the Alpine district, this includes a vast mosaic of landscapes spanning from the Adriatic coast to the highlands of the Alps and the Apennines.

2. Geographical and palaeoenvironmental background

The analysed area includes the modern Italian regions of Veneto and Emilia Romagna and covers a surface of around 40,000 km^2 stretching north-west/south-east (Fig. 1). It is crossed in its mid part by the river Po with its numerous southern tributaries originated in the Apennines and by the rivers Adige, Bacchiglione, Brenta, and Piave running northwest to southeast in its north-eastern sector. Both the Po and the Venetian rivers flow into the Northern Adriatic Sea. Standing out in the middle of the Venetian plain, two isolated mountain groups, Monti Berici and Euganei, reach altitudes of 450 and 600 m respectively.

In the Venetian region, the highland part is mostly included within the Dolomites, with a Permian to Cretaceous sequence mostly composed of sedimentary rocks, with interbedded volcanic layers. Towards the south, the pre-Alps are formed of Mesozoic and Cenozoic sedimentary rocks, mainly limestones, sandstones, and pelitic sediments. Some of these formations, in particular the

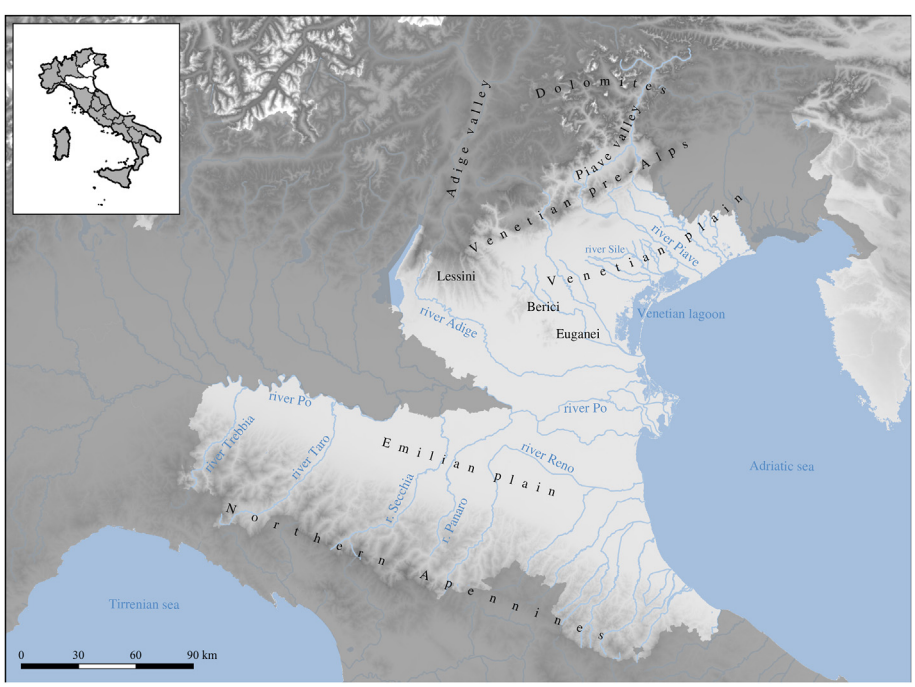

Fig. 1. Location of the investigated territory with indication of the main geographic entities.

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Cretaceous ones, are very rich in cherts. The Piave represents the main river system of this area, and it is among the best known in the Southern Alps as far as its evolution is concerned, showing several similitudes with the river Adige which delimits this area to the west (Bassetti and Borsato, 2007; Carton et al., 2009).

The deglaciation process in the Piave area started before 15 ka ^{14}C BP (Carton et al., 2009). In the early Late Glacial the valley was invested by several large landslides among which, the Fadalto one that caused the formation of S. Croce Lake while the Marziai landslide determined the formation of a lake about 20 km long, which was filled by sediments between 17 and 15 ka ^{14}C BP (Pellegrini et al., 2006; Carton et al., 2009). Several layers of lacustrine silts were thus deposited in the valley and later covered by alluvial gravel and silt sediments in the following phases. Starting from the end of the Late Glacial and the Early Holocene, sedimentation was followed by channel bed down-cutting, accompanied by the formation of river terraces (Surian, 1996).

The dates of 14,765 ± 135 ^{14}C BP (17,303–18,544 years cal BP) and 14,370 ± 115 ^{14}C BP (16,708–17,786 cal BP) obtained from core drilling at Revine (TV), at the entrance of the valley, indicate that the Piave area had been colonised by steppe vegetation by this age. From about 15 to 8 ka ^{14}C BP, the development of forests in the Vallone Bellunese, the mid-part of the Piave river valley, running longitudinally to the mountain chain and separating the pre-Alps from the Alps, is documented by pollen data. The first phase was characterized by open vegetation with *Pinus mugo* scrub and shrub-tundra followed by the development a forest dominated by conifer trees (especially *Larix decidua*) after 12 ka ^{14}C BP as documented at the Palughetto bog (1040 m a.s.l.) in the Cansiglio Plateau and at Modolo (424 m a.s.l.) (Table 1) on the southern slope of the Vallone (Pellegrini et al. 2005; Vescovi et al. 2007). At the beginning of the Holocene, a mixed forest with conifers and thermophilous trees started to develop (Carton et al., 2009). The expansion of forest vegetation, with a tree line 100–150 m higher than at present during the Atlantic, may have favoured the stability of the valley slopes during the Lateglacial and the beginning of the Holocene.

The Venetian plain area is characterised by the presence of three alluvial megafans. The Montebelluna megafan (Piave river) is the most ancient (pre-LGM) and it outcrops in the piedmont area while its distal parts are covered by the Bassano (Brenta river–LGM) and Nervesa (Piave river–LGM) megafans. The latter extends from the Southern Alps piedmont area to the present Lagoon of Venice. Their distal parts are less steep than the proximal ones and include systems of fluvial ridges and elongated depressions (Carton et al., 2009). After a long period of alluvial aggradation (maximum glacial expansion and deglaciation phase) between the Lateglacial and early Holocene the alluvial plain underwent a severe erosive phase while after ca. 8 ka ^{14}C BP down-cutting in the Vallone Bellunese re-mobilized the alluvial sediments and contributed to delta formation on the Adriatic coast (Mozzi, 2005; Pellegrini et al., 2005; Fontana et al., 2008; Carton et al., 2009). Marked soil development (*caranto*) took also place, and since the Early Holocene the oak forest probably extended in the Venetian plain and the lagoon (Carton et al., 2009).

In the Southern Po plain area, several tributaries of the river Po find their sources in the inner Emilian Apennines and flow mostly with a south-western/north-eastern orientation. During their course, they shape the reliefs of the Apennines, mostly composed of weak sediments (sandstones, marls and clays). In their lowest parts, they form several terraced surfaces within the pebbly and sandy alluvial deposits of the middle–upper Pleistocene that extend towards the plain as alluvial fans (Carta Geologica d'Italia). Between the end of the Pleistocene and the early Holocene, the retreat of glaciers in the Apennines caused a reduction of erosive phenomena and brought about the progressive stability of the soils along the mountain slopes, following the expansion of arboreal vegetation. Nevertheless, the study of some deposits located at mid-high altitudes (1600–1800 m a.s.l.) in the Apennine area of Reggio Emilia, has shown the persistence of conditions of low vegetal cover and of erosion phenomena up to the beginning of the Atlantic period (Biagi et al., 1980). At the same time, in the plain the deposition of coarse alluvial sediments had been replaced by that of finer deposits. Particularly around the boundary of 12 ka BP, especially in the most subsided areas of the plain, the formation of deep silty deposits is associated with clays rich in vegetal remains which indicate the presence of stagnant waters. In the following phase (around the mid-Holocene), the Apennine rivers had formed suspended well drained channels and filled the plain with their fine sediments by subsequent flooding of the area (Valloni and Baio, 2008). In the Preboreal the vegetal landscape of the plain was dominated by *Pinus* (mainly Scots Pine), followed by *Abies* and *Picea*. From the Boreal onwards, deciduous mixed-oak forests spread, accompanied by abundant *Tilia*. In the Apennine area, at lower altitudes, mixed broadleaved woods always prevailed, with refuge locations for *Castanea* and *Juglans* in the Preboreal and Boreal. Conifers, particularly *Pinus* (accompanied by abundant *Abies*) was the best represented species in mountainous environments from the Preboreal to the Atlantic (Accorsi et al., 1999).

3. The Venetian archaeological evidence

The distribution of sites in the Venetian area is not homogenous but it appears concentrated in specific areas. Although this pattern could partly represent a consequence of research biases, it also seems to reflect the preference of human groups for some topographic locations, which could correspond to specific sites functions/specializations and/or seasonal occupations. From the plain to the highlands, sites can be found as follows (Fig. 2):

a) A small group of low plain sites is distributed not far (less than 20 km) from the present Adriatic coast and the Venice Lagoon (Altino, Dese), although at the time of settlement these were placed much innermost within the Venetian plain, being the Preboreal and Boreal coastline some tens of kilometres away from the present one (Lambeck et al., 2004). These sites are exclusively represented by surface lithic scatters, indicating that occupation of this area continued up to the Atlantic period. They have a rather high number of cores with respect to retouched and raw blanks (Broglio et al., 1987). Raw materials seem to indicate provisioning from river beds, but also from the primary outcrops located in the pre-Alpine belt. New studies on these assemblages are in progress.
b) The spring-line located at the transition between the so-called "high" and "low" sectors of the alluvial plain has yielded several open-air sites which have been mostly the object of surface collections. Although these were first identified in the 1980s, only very recently have the richest of these areas, that of the Sile river springs, been the object of a new research project aimed at the systematic collection of surface finds and the identification of *in situ* deposits by trench opening (Fontana et al., 2016) (Fig. 3). The first results indicate a very intensive occupation, particularly of the slightly raised sandy areas that characterize this alluvial context of braided river courses. Several thousand artefacts have been collected, documenting that settlement took place starting from the early Holocene (possibly from the last part of the Late Glacial) throughout the Atlantic period and in more recent periods.

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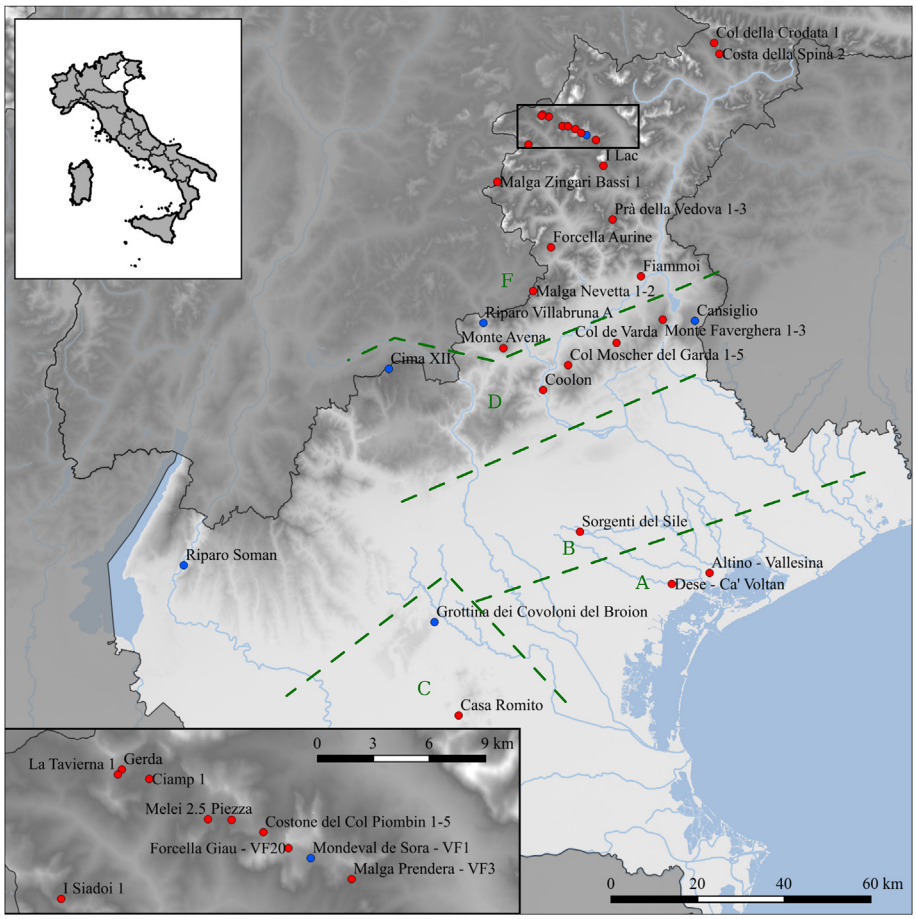

Fig. 2. Location of the Sauveterrian sites of the Venetian area. Blue dots indicate excavated sites; red dots indicate lithic scatters; green letters and dashed lines refer to the groups numbered and described in the text. Group "E" is not indicated as it is composed of valley bottom sites included in the area corresponding to "D" and "F". (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

c) An open-air (Casa Romito) and a cave site (Grottina dei Covoloni del Broion) were respectively investigated on the low reliefs of Monti Euganei and Berici. Casa Romito is located in the Valcalaona on a sandy hill which is slightly relieved with respect to surrounding areas; it has been attributed to a mid-recent phase of the Sauveterrian (Peresani et al., 2000; Peresani, 2013). At Grottina dei Covoloni del Broion, the Sauveterrian occupation is followed by a Castelnovian one. Although excavated in the 1970s, analysis of the archaeological evidence brought to light in the Sauveterrian deposits over a small area within this small cave has just started. The lithic assemblage is not particularly abundant, considering that the site has only been the object of a small stratigraphic trench. The presence of perforated marine shells and of ochre residues suggests a strategic role for this settlement (Broglio, 1984). The study of faunal assemblages is also in progress.

Fig. 3. Panoramic view of the area of the Sile river springs where numerous lithic scatters have been identified.

d) A further group of sites has been identified along the pre-Alpine ridges that delimit the Vallone Bellunese to the South (Col Moscher and Monte Faverghera) as well as on the pre-Alpine karst reliefs of the Asiago and Cansiglio plateaus with altitudes spanning from 1000 to 1600 m a.s.l. The first are only known by surface collections (Cesco Frare and Mondini, 2005) while some of the latter have been the object of extensive explorations. In the western slope of the Cansiglio Plateau, a systematic survey led to the discovery of numerous sites between Casera Lissandri and Casera Davià (Fig. 4) Three have been extensively excavated and have yielded Sauveterrian assemblages (Casera Davià 2, Casera Lissandri 1 and 17). For Casera Lissandri 17, a radiocarbon date is also available that locates the settlement in the Preboreal: 8808–8562 cal BC (2σ, 9410 ± 50 BP, Poz-9919) (Table 1). A recent techno-economic analysis of the lithic assemblage has confirmed the preliminary interpretation of the settlement as a hunting-oriented site. Arrowheads and

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Fig. 4. The western slope of the Cansiglio Plateau where numerous Early Mesolithic sites have been identified (Photo D. Visentin).

barbs were produced on site; they are definitely dominant in the remaining tool assemblage and probably represent the main aim of the lithic production. The only other activities carried out on the site, as documented by typological and traceological analyses, can be connected with primary processing of the carcasses. An interesting aspect is that although raw materials were almost entirely collected in the middle Piave valley (a few kilometres to the west of the site), a rock crystal bipolar core and some flake fragments are also noted. Currently this evidence represents the southernmost for this raw material exposed in the central Alps (Peresani and Angelini, 2002; Peresani, 2009; Peresani and Bertola, 2009; Peresani et al., 2009; Visentin et al., 2015a). Another Early Mesolithic settlement has been identified in the Palughetto basin and dated to the mid Preboreal (Peresani et al., 2011) (Table 1). At Cima XII on the Asiago Plateau, 27 sites have been identified on a gently dipping slope between 2030 and 2118 m a.s.l. Four of them have been excavated, but only the two most numerous lithic assemblages (CD3 and CD9) have been analysed. Chert provisioning took place primarily on the Asiago Plateau. Local raw materials were exploited for the production of lamellar and micro-lamellar blanks. Microlithic arrowheads and barbs dominate both assemblages, although tools are also abundant. Techno-typological features allowed the authors to date the CD3 lithic assemblage to the middle Sauveterrian phase and that from CD9 to the recent Sauveterrian phase (Broglio et al., 2006).

e) On the valley bottom and the river terraces of the pre-Alpine fringe, a few sites are also known. To the west of the analysed area, Soman rock-shelter is located at the entrance of the Adige valley, between the Baldo Chain and the Lessini Plateau. Its first occupation dates to the Late Glacial when the area became ice free. Therefore, in this site Sauveterrian layers (str. 4 and 5–7) overlie the Epigravettian ones (str. 13–15, 16, 17–23) (11,880 ± 170 BP–13,363–14,089 cal BP) (Broglio and Lanzinger, 1985). This is one of the few sites in the examined territory to have yielded faunal remains. Particularly, the layers referred to the transition phase between the Epigravettian and the early Mesolithic (Recent Dryas?–Preboreal?) reflect the dominance of species still adapted to cold and dry environments, with ibex followed by chamois. After a gap in the occupation of the site, evidence from the Boreal layers indicate an increase of forested species, namely red deer, roe deer and wild boar, with a persistence of *Capra ibex/Rupicapra* (Tagliacozzo and Cassoli, 1994). The lithic assemblages have only been the object of a preliminary analysis and they are represented by a low number of elements (Battaglia et al., 1992). Inside the Adige valley, several other valley-bottom sites are known, including the Romagnano rock-shelter. These have been the object of numerous works, but as they are located in the Trentino-Alto Adige region they will be not discussed in this paper (Broglio and Kozlowski, 1983; Kozlowski and Dalmeri, 2000; Dalmeri et al., 2008; Flor et al., 2011). Further east, three other sites are recorded. On the bottom of the Cismon valley, a right tributary of the river Piave, the Villabruna site is located. This rockshelter is better known for its Epigravettian occupation and a well-preserved burial dated to the same age. Data on the Mesolithic frequentation of this site comes from rock-shelter A (layer 3) where a few elements have been brought to light, including a Sauveterre point (Aimar et al., 1992). Further evidence comes from the Coolon rock-shelter, located on the left slope of the Piave valley (Quero canyon), where some Sauveterrian-like artefacts coming from an almost completely destroyed deposit have been recovered (Peresani, 1996), and Col de Varda-Sant'Antonio di Tortal, located on a river terrace formed by a tributary of the river Piave (left side). Further inside the Piave valley, the site of Fiammoi is also known only by surface collections (Cesco Frare and Mondini, 2005).

f) The last group of sites in this area comes from the highland of the inner Alpine territory (Belluno Dolomites). In the southernmost part of the area, only some surface lithic scatters are known at altitudes between 1450 m a.s.l. (Monte Avena) and 1700 m a.s.l. (Malga Nevetta) while much richer evidence comes from the innermost area, the upper basin of river Piave and of its main right tributaries (the Maè and Cordevole rivers) with altitudes spanning from 1700 to 2300 m a.s.l. Here, sites are located in recurrent positions (near passes, small lakes, dominating positions, etc.) and are particularly numerous along the watershed that separates the Cordevole from the Fiorentina and Boite valleys. This is especially due to the intense surveys carried out in this area over the past years which have been confirmed by a recent research field project (Fontana and Pasi, 2002; Fontana et al., 2002; Cesco-Frare and Mondini, 2005; Visentin et al., 2015b, 2016). Among the numerous sites identified, only VF1 of Mondeval de Sora has been the object of extensive excavations (Fontana et al., 2009a, 2009b) (Fig. 5). It is located under a large erratic boulder at the centre of the wide Mondeval basin at an elevation of 2130 m a.s.l., flanked on the western, northern and eastern side by Dolomitic reliefs and facing

Fig. 5. The site of Mondeval de Sora located at 2130 m a.s.l. under the rock-shelters formed by the large erratic boulder in the Belluno Dolomites (Photo D. Visentin).

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south on the Cordevole valley with a steep slope. From sector I, lying under the south-western side of the boulder, come two thick layers (SUs 8 and 31) that covered some dwelling structures, a paved area (SU 14), an accumulation of dolomite boulders that delimited the paved area (SU 33) and a fireplace (SU 32). These have all been referred to the Sauveterrian (Fontana and Vullo, 2000). The archaeological evidence from SU 8 (GX-21788 – 9185 ± 240 BP i.e. 9175–7731 cal BC, 2σ) (Table 1), representing a palimpsest of several occupation phases, contained a rich lithic assemblage associated to abundant faunal and charcoal remains (Fontana et al., 2009a, 2012; Berto et al., 2016). Sector III is located on the northern side of the boulder and is characterized by a 50 cm thick stratigraphic series, including an early Mesolithic sequence documenting at least three main occupation phases. Two 14C dates are available respectively for the most ancient (SU 32 – GX-27748: 9160 ± 90 BP, 8613–8243 cal BC, 2σ) and the most recent one (SU 10 – GX-21797: 8445 ± 50 BP, 7587–7370 cal BC, 2σ) (Table 1) both attesting an occupation during the Sauveterrian (Fontana et al., 2009b, 2015; Valletta et al., 2016). In both sites, lithic assemblages are mostly manufactured on good quality regional cherts from the Piave valley and, to a lesser extent, on local ones. Reduction is essentially aimed at the production of projectile elements with the microburin technique for the manufacture of arrows and secondarily of some tool categories (Fig. 6). Results of studies in the two sectors have allowed interpreting this site as a seasonal base camp showing a functional emphasis on activities of provisioning and processing of animal carcasses. The latter belong mainly to red deer and ibex, the hunting of which was favoured by the optimal location of the site at the transition zone (ecotone) between the montane and subalpine/alpine zone where such preys could be hunted during the spring–summer season. To conclude, ongoing research at Casera Staulanza (1700 m a.s.l., at the limit of the high basin of the river Maè) has produced evidence referring to a Boreal occupation of the area, together with the most ancient record of a Lateglacial frequentation (unpublished). Only one radiocarbon date referring to the Boreal occupation of the site is available (Table 1).

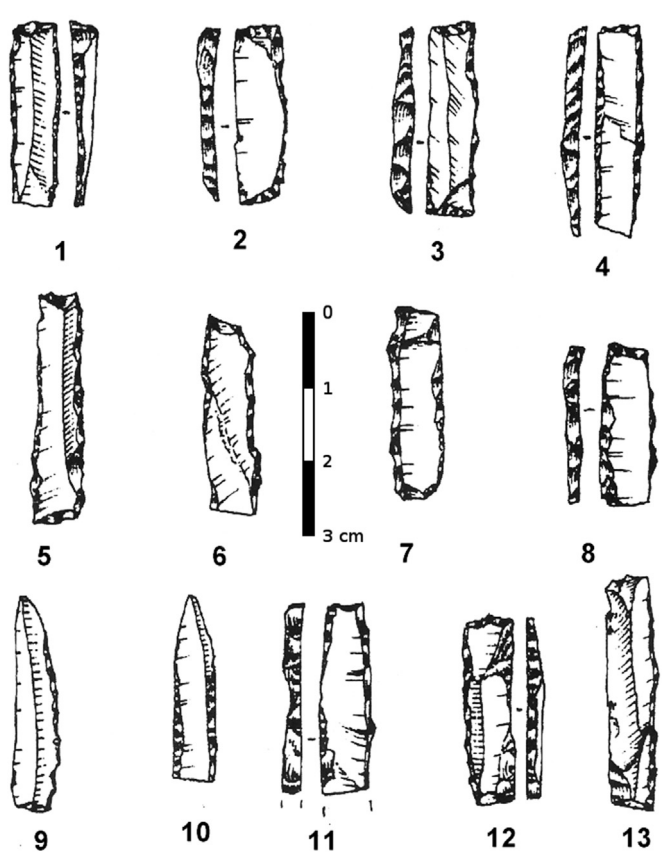

Fig. 6. Mondeval de Sora, lithic assemblage: standardised truncated bladelets and backed points obtained from the same flint core, scale1:1 (Drawings G. Almerigogna).

4. The Emilian archaeological evidence

In the Emilian area, sites have been identified in three major topographic situations which are strictly connected to the specific morphology of this territory (Fig. 7).

a) In the plain, a group of open-air sites was investigated in the last twenty years, mostly by rescue-excavations. All except one are located at the top of the alluvial fans of some main Apennine streams (Collecchio, near Parma; I.N.F.S., Casalecchio and Cava Due Portoni, near Bologna). The last one (Le Mose, Piacenza) is situated in the lowermost part of the plain near the confluence between the Nure and the Po rivers. A radiocarbon chronology is available for this site (9220 ± 50 BP, 8560–8300 cal BC, Poz-13344 for S.U. 507, Pl. 19 S and 8250 ± 50 BP, 7460–7130 cal BC, Poz-13343 for S.U. 507 – Locus 7) (Table 1). Based on the techno-typological characteristics of the lithic assemblages, a Preboreal age has been proposed for Collecchio and INFS and a Boreal one for Casalecchio and Cava due Portoni (Fontana et al., 2009c, 2013). The attribution of Collecchio is also confirmed by two radiocarbon dates (Visentin et al., 2014) (Table 1). Palaeoenvironmental data are limited. A few charcoals and very fragmented faunal remains have been collected at all the sites, although species determination is available so far only for I.N.F.S. and Collecchio where species adapted both to open and wooded environments are reported (hare, wild cat, roe dear and wild boar) (Farabegoli et al., 1994). At Collecchio, charcoal remains are associated with some burned hazelnuts shells (*Corylus avellana*) (Visentin et al., 2014). All sites extend over surfaces that vary between 30 and 75 m^2, with the exception of Le Mose. This vast site covers an area of about 20,000 m^2 with over 20 identified *loci* (Bernabò Brea et al., 1998; Fontana et al. in press-b). Only Cava Due Portoni has yielded a structured fireplace, consisting of an irregular elliptical pit (Cremaschi et al., 1990) while other hearths were recognised by spatial analysis at Casalecchio, I.N.F.S. and Collecchio (Farabegoli et al., 1994; Fontana et al., in press-a; Visentin and Fontana, 2015). At most sites lithic assemblages are dominated by armatures. Only at Collecchio and some *loci* at Le Mose are tools more represented than microliths. The latter do not always include the whole set of typical Sauveterrian types, but frequently triangles are absent or just represented by a few elements (I.N.F.S., Collecchio). Among all the sites, Collecchio displays a peculiar structure by its burin dominated retouched assemblage which is associated with a rich set of debitage waste and cores among which several burin-like cores (Fontana and Cremona, 2008; Visentin et al., 2014) (Fig. 8). Lithic raw materials were mostly collected on a local base: these are represented by small chert pebbles from the marine formations of the Apennine margin and large silicified nodules from river deposits in the western sites (Bologna area), and by cherts from the local Mesozoic and Cenozoic formations in the eastern ones (Parma and Piacenza area). The only

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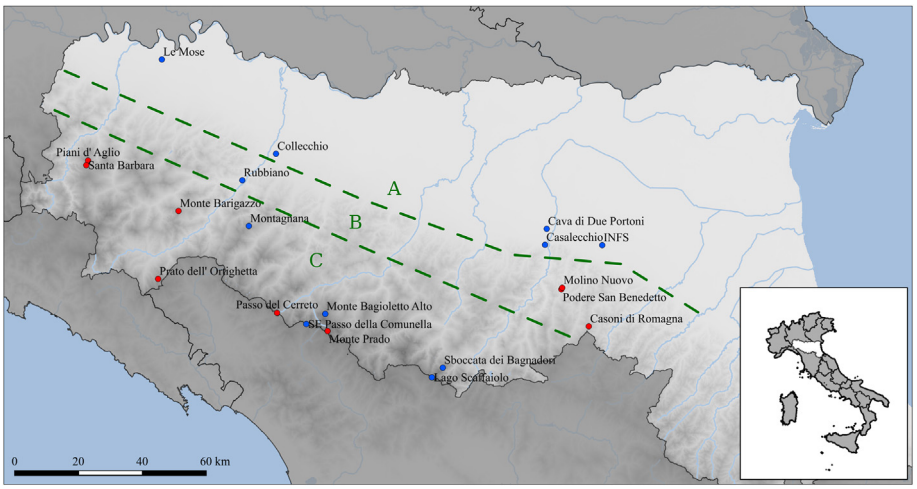

Fig. 7. Location of the Sauveterrian sites of the Emilian area. Blue dots indicate excavated sites; red dots indicate lithic scatters; green letters and dashed lines refer to the groups numbered and described in the text. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

evidence attesting a provenance over longer distances comes from Cava Due Portoni, in the Bologna area where, in addition to cherts from the Apennine formations, the presence of allochthonous/regional and possibly extra-regional raw materials has been detected, indicating possible east–west (Piacenza Apennines?) and south–north (pre-Alpine area?) movements and/or contacts (Fontana et al., in press-a). On the basis of the available record, both Casalecchio and INFS can be considered as short-term hunting camps while archaeological evidence from Cava due Portoni seems to indicate longer periods of stay, although in contrast with its armature-dominated lithic assemblage (Visentin and Fontana, 2015). Evidence from Collecchio reflects a dominance of domestic over hunting activities while the different loci of Le Mose indicate a high variety of situations. Unfortunately, excavation techniques adopted at this site do not allow further considerations to this concern. Sites of the southern Po plain seem to correspond to ecological niches with a high primary productivity of both vegetal resources and permanent and migratory faunal species (fish, freshwater molluscs, land snails, reptiles, amphibians, mammalians and birds) (Biagi et al., 1980).

b) The hilly terraced surfaces ("Pedeappenines") that delimit the main Apennine valleys at altitudes between 150 and 700 m have yielded only a few sites. Molino Nuovo, Podere San Benedetto and Casoni di Romagna in the Bologna area are respectively located at 210 m a.sl. along the Savena valley and at around

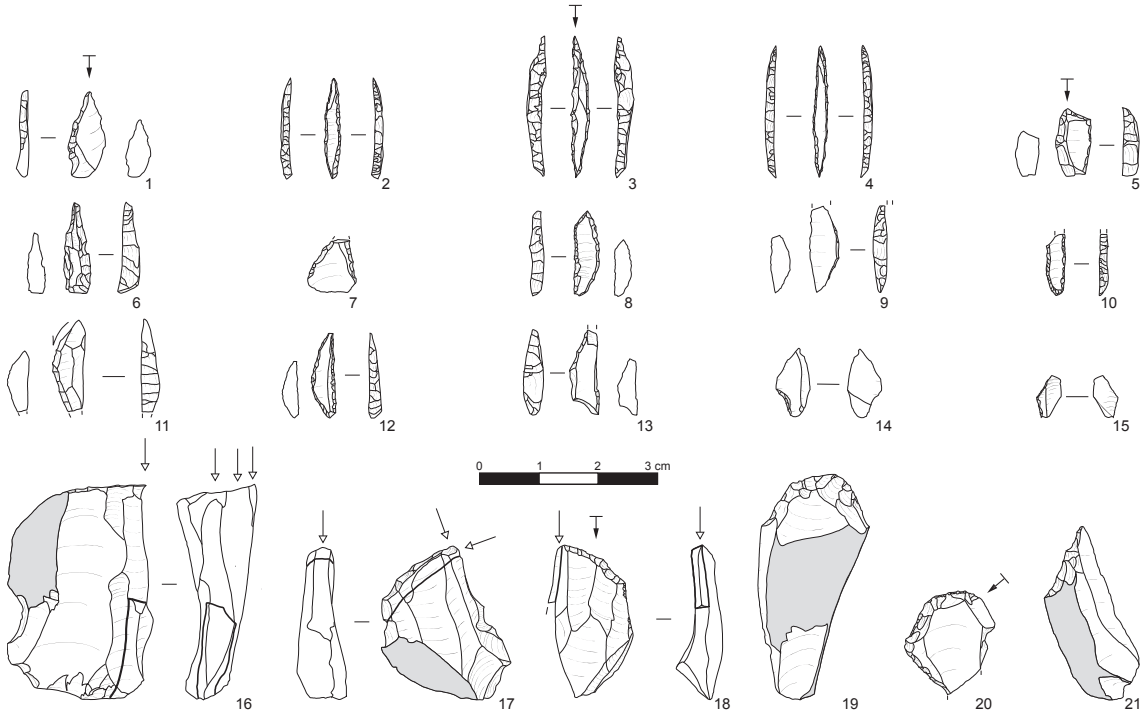

Fig. 8. Collecchio, lithic assemblage: 1. backed point; 2–4. double backed points; 5. backed and truncated bladelet; 6. backed and truncated point; 7. backed fragment; 8–12. crescents; 13. scalene triangle with impact fracture; 14. microburin; 15. Krukowski microburin; 16–18. burins and corresponding burin spalls; 19–20 endscrapers; 21. oblique truncated bladelet (Drawings by S. Ferrari).

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700 m above a.s.l. (the latter) on the watershed between the Idice and the Sillaro valleys. Rubbiano is situated in the area of Parma on an alluvial terrace at the convergence between the Taro and Ceno rivers, a few kilometres upstream of Collecchio, at an altitude of about 156 m. Analysis of the assemblage yielded by the site of Rubbiano is still in progress while the three sites in the Bologna area have yielded only poor lithic assemblages after surface collections (Cremaschi, 1985). Besides this weak record, the hilly band could be of high potential interest for the Sauveterrian populations, thanks to its good insolation and availability of lithic and water resources.

c) The mid-highlands (between 1100 and 1800 m) mostly corresponding to dominating locations and often near small lakes and passes have yielded the richest evidence of the region in terms of site number (Biagi et al., 1980; Ghiretti and Guerreschi, 1990; Fontana et al., 2009c). They are mostly known both along the main Tusco-Emilian watershed (Passo del Cerreto, Passo della Comunella, Monte Bagioletto and Monte Prado in the Reggio Emilia Apennines and Lago Scaffaiolo in the Modena Apennines) (Cremaschi and Castelletti, 1975; Biagi et al., 1980; Cremaschi et al., 1984; Fontana, 1997; Ferrari and Fontana, 2006) and the main inter-valley systems (Santa Barbara, Piacenza, Prato dell'Ortighetta and Monte Barigazzo, Parma, Sboccata dei Bagnadori, Bologna) (Ghiretti and Guerreschi, 1990) (Fig. 9). The richest information comes from the site of Bagioletto Alto, situated at an altitude of 1725 m in the Apennines of Reggio Emilia (Cremaschi et al., 1984), which has also yielded a date of late Boreal age (Table 1). Archaeological investigations at this site have allowed the identification of two main archaeological horizons (IV B21 and IV B22), the latter of which has also yielded a radiocarbon date (Table 1). The most ancient horizon (IV B22) covered some dwelling structures, namely an elongated pit with vertical sides, two postholes and other two small pits. Charcoal remains and burned cherts were concentrated at the centre of the elongated pit. The lithic assemblage was obtained mostly from local cherts coming both from the Emilian and Tuscan Apennine slopes but also from cherty marine pebbles of the Apennine margin and displays the most typical Sauveterrian features. This site has been interpreted as a seasonal residential camp.

Fig. 9. The site of Sboccata dei Bagnadori located on the pass joining the Silla to the Dardagna valley, in the Emilian Apennines.

warmest months of the year, such as those of the Alps. The main exception is represented by the preservation of charcoals at the highland sites of Reggio Emilia Apennines where *Abies* is accompanied by *Laburnum*, *Acer* and *Fraxinus*, suggesting that sites were located in open and damp areas close to forested environments (Biagi et al., 1980; Cremaschi et al., 1984).

5. Discussion

Archaeological data available for the analysed territory are not homogeneous both from the point of view of the number of sites for each analysed geographic area and the quality and quantity of the preserved record. As an example, in the Emilian area plain sites are far less numerous than mountain ones, but they are much better known considering they are all excavated deposits that have undergone multidisciplinary analyses. In spite of these limits, we will try to examine some of the possible facets of our record in order to discuss aspects that may contribute to the reconstruction of the territorial organisation of early Mesolithic hunter–gatherers.

Table 1
Radiocarbon dating available from the archaeological sites identified in the investigated area. Dates have been calibrated using OxCal v.4.2.4 and IntCal13 atmospheric curve.

Site	Sample	^{14}C age BP	Age cal BC (2σ)	Material
Collecchio	LTL6147A	9643 ± 70	9251–8814	Burnt hazelnut
Palughetto	GX-21231	9495 ± 50	9128–8638	Wood charcoal
Collecchio	LTL12390A	9442 ± 60	9119–8564	Wood charcoal
Casera Lissandri 17	Poz-9919	9410 ± 50	8808–8562	Wood charcoal
Le Mose, US 507, Pl 19S	Poz-13344	9220 ± 50	8565–8299	Wood charcoal
Mondeval de Sora (VF1-I-SU 8)	GX-21788	9185 ± 240	9157–7751	Wood charcoal
Mondeval de Sora (VF1-III-SU 32)	GX-27748	9160 ± 90	8613–8244	Wood charcoal
Mondeval de Sora (VF1-III-SU 10)	GX-21797	8445 ± 50	7588–7371	Wood charcoal
Casera Staulanza	LTL14119A	8433 ± 50	7585–7361	Wood charcoal
Bagioletto Alto, IV B22, Q.14 (bottom)	B/n 2839	8260 ± 60	7480–7084	Wood charcoal
Le Mose, US 507, Locus 7	Poz-13343	8250 ± 50	7460–7084	Wood charcoal

Generally, the preservation of organic remains is poor at all the known sites of the hilly and mid-highland area, and does not indicate the variety of vegetal and animal resources that were exploited in the different topographic contexts or provide information on the seasonality of occupations, although altitudes suggest that mid-highland sites must have been frequented during the

5.1. Diachronical evolution and geographic extension of human peopling

As a consequence of the extent of glaciers both on the Alps and the Northern Apennines, evidence of a LGM occupation of the examined regions appears very limited. In the Venetian area the

only available data come from the low reliefs of Monti Berici, indicating the incursion in the area of small hunting parties from the mid-Adriatic zone in the Early Epigravettian (Broglio et al., 2009). Re-peopling by human groups is thus documented starting from the Late Glacial by Late Epigravettian groups. Between 17 and 14 ka cal BP, the rock-shelter sites of Tagliente and Soman, respectively located at the entrance of the Pantena (Lessini Plateau) and Adige valleys, were occupied while in the temperate Interstadial human settlement extended to the pre-Alpine high-plateaux and the inner Alps at altitudes that do not exceed 1700 m (Broglio and Improta, 1994–95; Bertola et al., 2007). A significant increase in the number of sites is documented in the Preboreal and Boreal as well as their diffusion up to altitudes of around 2300 m a.s.l. by Sauveterrian hunter–gatherer–fishers.

This period also saw the first re-occupation of the Southern Po plain and the Northern Apennines. In this area, no evidence of a stable frequentation in the Late Glacial is known (Fontana et al., 2013). Although possible research biases and especially aspects connected to site visibility (in the plain) and preservation (along the Apennines where erosion processes lasted until the Atlantic) may have influenced this framework, the documented background seems mostly to be connected to the different environmental conditions that affected the Southern Alps and the Northern Apennines respectively during the first part of the Holocene. Further investigations are certainly needed in order to understand which processes could have led to a possible delayed occupation in the Southern part of the investigated territory.

As regards the Preboreal and Boreal periods, only a few radiocarbon dates are available, while some excavated sites can indirectly be dated to one of these two phases on the base of the techno-typological features of their lithic assemblages (Table 1). Both periods seem to be represented, showing a continuous occupation of this area in the Sauveterrian, which then continued during the Atlantic with the development of Late Mesolithic (Castelnovian) complexes.

5.2. Location and function of sites

The distribution and location of sites appear very varied in connection to the high geographic diversity of the examined territory, affecting both alluvial plains and high mountain areas, as well as valley-bottoms and hilly zones. They occupy both open-air and sheltered areas, with only one documented cave (Grottina dei Covoloni del Broion in the Monti Berici). Sheltered sites are only present in the Venetian area and generally less numerous than open-air ones. Most excavated deposits seem to develop over limited surfaces, although in several cases the partial investigations does not allow verification of their effective extents (Table 2). The presence of evident dwelling structures is rare with some exceptions such as Cava Due Portoni in the Southern Po plain, Monte Bagioletto in the Reggio Emilia Apennines and Mondeval de Sora in the Belluno Dolomites, while in other cases unstructured hearths have been recognised after spatial analyses (i.e. Collecchio, I.N.F.S. and Casalecchio in the Po plain). In several situations, a specialised function has been proposed which is either connected to hunting practices (i.e. I.N.F.S and Casalecchio in the Southern Po plain and Casera Lissandri and Mondeval de Sora in the Venetian pre-Alps and Alps) (Fontana et al., 2009a; Visentin and Fontana, 2015; Visentin et al., 2015a) or to some domestic activity, as at Collecchio (Visentin et al., 2014).

Some "extensive sites" are also known. However, only one of them has been stratigraphically investigated (Le Mose in the Southern Po plain). It appears composed of different loci, each of which seems to correspond to a single short term occupation. Although different functions are suggested by the compositions of the lithic assemblages, their contemporaneity and internal structure cannot be verified, due to the quality of archaeological data (Fontana et al., in press-b). A rather different situation can be observed in the plain sites of the Sile river springs. Although they have only been the object of surface collections, the high densities of recovered materials support the hypothesis of intense and recurrent occupations. Investigations are in progress in this area which will hopefully give more details on the settlement strategies (Fontana et al., 2016).

Data recorded from the most reliable sites, where stratigraphical excavations have been undertaken, show that the only attested rock-shelter site (Mondeval de Sora) features the highest densities of artefacts (Table 2). This density appears as the result of recurrent seasonal occupations within a mountain residential hunting camp (Fontana et al., 2009a). High values are displayed also by the open-air mountain hunting camps of Casera Lissandri and Cima Dodici 3, thus indicating recurrent occupations of the same spots over time. By contrast, open-air plain sites (I.N.F.S., Casalecchio, Le Mose, Collecchio) and the only open-air Apennine mountain site show lower densities of artefacts.

Table 2
Comparison of data on the composition of the lithic assemblages available from the main excavated sites of the investigated area (VF1 = Mondeval de Sora, sectors I and III).

	I.N.F.S.		Casalecchio		Le Mose, L. 3		Le Mose, L. 20		Collecchio		Bagiol. IV B22		VF1-I, SU 8[a]		VF1-III[b]		C. Lissandri 17		Cima Dodici 3	
	n.	%	n.	%	n.	%	n.	%	n.	%	n.	%	n.	%	n.	%	n.	%	n.	%
Blanks	3116	91.6	1032	93.7	289	77.7	704	90.4	7356	95.6	3411	93.6	17648	87.0	3496	69.9	10396	93.0	6546	92.9
Cores	13	0.4	14	1.3	5	1.3	8	1.0	100	1.3	19	0.5	46	0.2	20	0.4	49	0.4	18	0.3
Tools	45	1.3	14	1.3	6	1.6	12	1.5	148	1.9	65	1.8	166	0.8	104	2.1	64	0.6	39	0.6
Microliths	95	2.8	40	3.6	23	6.2	9	1.2	82	1.1	93	2.6	1229	6.1	674	13.5	348	3.1	102	1.4
Microburins	131	3.9	1	0.1	49	13.2	46	5.9	11	0.1	56	1.5	1206	5.9	710	14.2	322	2.9	338	4.8
Total	3400	100%	1101	100%	372	100%	779	100%	7697	100%	3644	100%	12229	100%	5004	100%	11179	100%	7043	100%
Explored area	~30 m^2		40 m^2		15–20 m^2		15–20 m^2		~65 m^2		31 m^2		~24 m^2		~10 m^2		23 m^2		25 m^2	
Density	113.3		27.5		21.3		44.5		118.4		117.5		845.6		500.4		486.0		281.7	

[a] Among the blanks around 10,000 burned pieces are included. Counting is still incomplete.
[b] Undetermined fragments smaller than 1 cm are not included in the sum; assemblages from all early Mesolithic layers have been grouped together.

5.3. Subsistence strategies

Direct economic data from the investigated regions are limited. Some more clues on the subsistence of hunter–gatherer groups can thus be supplied by the palaeoenvironmental record. During the Preboreal and Boreal, the region was mostly covered by forests with

the exclusion of the higher altitude band of the Alps and the Apennines. This situation is well documented at Soman rockshelter, in the Adige valley, where the Pleistocene–Holocene transition levels, dominated by species adapted to a cold environment, are followed in the Boreal by layers where wood environments species are prevalent (Broglio and Lanzinger, 1985). Therefore, the consumption of forest ungulates, namely red deer, roe deer and wild boar, with diverse proportions according to different areas, must have occupied an important role in the diet of Early Mesolithic hunter–gatherers during most part of the year, accompanied by smaller mammals such as the hare, the fox and the wild cat and an array of edible fruits, among which only hazelnuts are archeologically documented (at Collecchio, near Parma). Moreover, in several cases the location of the sites indicates the vicinity to wet environments (the Southern Po plain deposits, the plain sites of the Venetian area, those of the lower Piave valley and the Emilian hilly band). We expect that these areas could allow the presence of a wide range of species, here included birds, fish, tortoises as well as water and terrestrial molluscs. The most striking archaeological evidence in this sense, although out of the examined territory, is documented at Galgenbühel in the inner Adige valley (Alto Adige) where species such as the beaver, along with terrestrial and water molluscs and fish dominate the archaeological record (Wierer and Boscato, 2006). Moving to the high altitude area, the total absence of data from the greatest part of the known sites is balanced by the unusually rich information from Mondeval de Sora where an emphasis on ungulate hunting, namely red deer and ibex (accompanied by few other species, such as the chamois, the bear and the marmot) is documented in correspondence of an ecotone environment represented by the transition band between the forest and the Alpine grassland (Fontana et al., 2009a).

Due to the poor preservation of organic materials, further data can be obtained from other indirect evidence such as the calculation of the incidence of some lithic categories (debitage blanks vs. cores, tools vs. armatures and armatures vs. microburins) (Table 2). These values can be used as clues for evaluating some economic and functional trends within the sites (Broglio and Lanzinger, 1990). Even considering the bias due to the partiality of some collections – as a consequence of the excavation of only parts of the sites – some patterns appear: a) the number of cores with respect to blanks is rather constant with values between 0.2 and 1.3; the value does not change also when considering sites such as Cima Dodici which is located in proximity of some chert outcrops; b) microlith-dominated assemblages are far more numerous than tool-dominated ones: the latter are only represented by Collecchio and Le Mose Locus 20; c) microburins record very variable incidences which reach, in some cases, three times the number of microliths, while in others they are nearly absent.

5.4. Seasonality

As a consequence of the paucity of the organic record, data on seasonality remain almost unavailable with the exception of Mondeval de Sora (Fontana et al., 2009a), the location of which would not leave any doubt of a late spring–summer–early autumn occupation, a consideration which appears valid also for all other high mountain sites in the Alps and the Apennines. By contrast, we do not have any information on the period/s of occupation of the settlements located in the valley-bottom, hilly and plain zones (although interesting comparisons are available from Galgenbühel, see Wierer et al., 2015). This aspect appears particularly challenging for the Venetian area, where the band of available plain territory was rather wide and, included coastal areas that are presently submerged. It would therefore become crucial to understand whether this territory was occupied by the same groups that where settled in the Alps or, alternatively, by different ones (Fontana, 2011).

5.5. Material culture

Material culture at all the sites is almost exclusively represented by lithic assemblages, while osseous implements are rarely noted. A few sites have yielded evidence of objects connected to a symbolic sphere, represented by some marine shells and red deer atrophic canines used as ornaments (Mondeval de Sora, Grottina dei Covoloni). The presence of ochre residues is also documented at these two sites. No burials are attested, but two are known in the near Adige valley (Trentino area), which are referred to two female individuals (Corrain et al., 1976; Dalmeri et al., 2002).

At all the sites, lithic collections show the exploitation of local and regional siliceous rocks while the presence of items made on exotic raw materials is not recorded. Only at Borgo Panigale, in the Bologna area, could a few implements indicate an extra-regional provenance (Fontana and Cremona, 2008). The main documented reduction sequence follows the typical “pragmatic scheme” known for the Sauveterrian, aimed at the production of irregular bladelets and flakes by the exploitation of small nodules/pebbles/blocks and thick flakes with unidirectional removals and eventual re-orientation of core platforms over the same or new surfaces (the so-called polyhedral and peripheral cores included), starting either from a natural convexity/edge or a flat surface.

Some peculiarities can also be recognised that involve the reduction sequences as well as the types of retouched artefacts produced. These peculiarities are possibly connected to the specific chronology of the sites, the raw material availability and the site function with no possibility to assess the role of each of these factors in most cases. Within the analysed area, considering only assemblages for which a systematic study is available, this aspect is more evident at some of the sites of the Southern Po plain. Here, the occurrence of a “local variation” of the “classical” Sauveterrian reduction system is attested: it is a secondary *chaine opératoire* having, as starting blanks, large nodules of raw materials of varied quality (silicified siltstone with different properties) and aimed at the production of large laminar flakes used either for their coarse cutting edges (Collecchio) or modified by retouch into scrapers, denticulates and backed knives (I.N.F.S, Casalecchio, Borgo Panigale). At Collecchio and INFS, the microlithic assemblage is obtained from a separated reduction sequence and almost exclusively composed of (double) backed points and crescents (with only one triangle at Collecchio). At the other sites of the Po plain (Casalecchio, Borgo Panigale, Le Mose) silicified siltstone is also used, even if not systematically, for the production of microliths, along with chert. At all these sites, with the exception of some loci of Le Mose, the microlithic assemblages are also composed of triangles, both scalene and isosceles which are usually predominant over backed points (especially double backed ones), crescents and backed truncated bladelets (often characterised by an obtuse angle) according to the most “classical” composition of Sauveterrian assemblages. This composition is also attested at the Alpine sites of Mondeval de Sora, Casera Lissandri XVII, Casera Davià II and Cima XII, where cherts belong to the Venetian series (from bottom to top: Maiolica, Scaglia Variegata and Scaglia Rossa) with lower percentages of other local types (Livinallongo formation at Mondeval de Sora) (Peresani and Angelini, 2002; Broglio et al., 2006; Fontana et al., 2009a; Valletta et al., 2016; Visentin et al., 2015a) and at the mountain Apennine site of Monte Bagioletto (Cremaschi et al., 1984).

Analysis on the chronological evolution of the lithic assemblages is still in progress, although some trends have already been highlighted, particularly starting from the microlith typology

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(progressive decrease of crescents and backed truncated bladelets along time, increase of triangles especially of the scalene type and with three retouched sides and decrease of the isosceles type). Casera Davià II is dominated by backed truncated bladelets and backed points possibly attesting a rather ancient age (Peresani and Angelini, 2002). An ancient chronology is also attested at Collecchio by radiocarbon data. INFS seems to be referred to the Preboreal by its lithic assemblage as well as some of loci at Le Mose (almost exclusive presence of backed points and crescents) while most other sites show a late Preboreal/Boreal age (Fontana and Cremona, 2008; Fontana et al., 2009c).

6. Conclusions

The analysis of the Sauveterrian record from the north-eastern sector of Italy enables us to propose some hypotheses on the territorial organisation of the local groups of hunter–gatherers. From a diachronical viewpoint, the considerable increase in the number of attested sites in comparison to the former period (Late Epigravettian) and their extension from lowlands to highlands and all over the examined territory seem to indicate a demographic growth which was possibly favoured by the improved environmental conditions and good availability of a wide range of resources. In the Apennine sector this process probably started in the early Holocene, while it followed a progressive development in the Alps where human re-occupation is dated to the first part of the Late Glacial and expands progressively during the Late Glacial Interstadial and the early Holocene.

Rivers can be identified as the main mobility routes of early Mesolithic groups. This aspect is evident in the Emilian area where the exploitation of local lithic raw materials collected in the corresponding Apennine valleys is attested at all the five lowland sites and a similar situation is highlighted in the Venetian area for the river Piave and its tributaries. We can thus infer a social organisation based on the presence of small size groups that were characterised by a mobility based on seasonal displacements from the plain/valley-bottoms to highland territories within an embedded procurement system. These groups could correspond to some sort of local bands having as their main territorial base the different drainage systems. Nonetheless, in the Venetian area the reconstruction of the settlement pattern could be more complex in relation to the presence of a wider plain territory extending up the coast with respect to the Emilian one whose northern limit was represented by the course of the river Po. This would imply either the possibility that this plain area was part of the same territorial network that could support the presence of bigger and more numerous groups as suggested by the larger dimensions of the river Piave basin or of a separated one that was focused on the exploitation of plain and coastal resources. The type of mobility – residential vs. logistical vs. other – remains uncertain due to a scarcity of data on the seasonality of occupations and the functional vocations of most sites.

To conclude, at a larger scale the course of the river Po seems to have played a major role, by partitioning this area into two main large territories – the Venetian and the Emilian. Such a division is not only marked by the raw material circulation but also by some techno-typological peculiarities that characterise the lithic assemblages, especially during the Preboreal. Specific land use strategies seem thus to have developed for each of the two regions, which appear strictly connected to their geographical, geological and ecological features. The different altitudes occupied by human groups in the two mountain domains – reaching over 2300 m a.s.l. in the Alps and around 1800 m in the Northern Apennines – the respective times needed to get to the mountain camps from the plain (at least twice longer in the Alps with respect to the Apennines), the presence of plain areas of different extension and the diverse distribution of animal, vegetal and lithic resources across the territory must have brought about the development of peculiar systems of organisation for each area. At the same time, the diffusion of a forested environment possibly enhanced a process of enlargement in the foraging spectrum of hunter–gatherer–fishers also leading to a reduction of the land exploited by each single group. In this respect, the Sauveterrian lithic technology (based on the use of raw materials of varied quality and morphology that could be collected on a local base and regulated by a pragmatic approach) has probably played a major role by facilitating adaptation of human groups to the different ecosystems encountered. We suggest that this "pragmatic" technology must have represented one of the key aspects of the settlement system adopted by early Mesolithic hunter–gatherers.

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